

#### Appendix 4: Historic California Tsunami Events

From: Tsunamis Affecting the West Coast of the United States, 1806 - 1992, Lander, J.F., Lockridge, P.A., and Kozuch, M.J., 1993 unless otherwise indicated. Dates Universal time – local date is one day earlier in some cases.

Year Month/day	Origin of Tsunami	Validity *	Cause **	Location of Effects	runup (m)	Comments
1700 1/26 <sup>1</sup>	Cascadia subduction zone		E	Crescent City Lagoon Creek Orick	> 7 > 7 18 ?	paleotsunami deposits paleotsunami deposits estimated from Yurok stories
1806 3/24	S. California	2	E?	Santa Barbara	Observed	Boats beached.
1812 12/21	S. California	4	L	El Refugio  Santa Barbara Ventura	3.4  2.0 2.0	Anchored ship drifted up canyon. Estimated runup. Estimated runup.
1840 1/16- 18	N. California	0	M?	Santa Cruz	Observed	Church tower collapsed, flooding may have been of meteorological origin.
1841 <sup>2</sup> 7/3	Kuril Is.	0	E	San Diego	Observed ?	Marigrams not found.
1851 11/13	N. California San Francisco	1	E	San Francisco Bay	Observed	Unusual water movement felt on ship. Possible seiche.
1852 11/25	N. California San Francisco	1	E	San Francisco	Observed	Lake Merced drained.
1853 November?	Kuril Is.	0	E	San Diego	Observed ?	Marigrams not found.
1854 5/31	S. California	3	L	Santa Barbara	Observed	Sea agitated. Heavy swell. Not recorded.
1854 7/24	S. California	2	?	San Diego	<0.1	Current set up in a calm harbor.
1854 10/4	Unknown teletsunami	3	?	San Francisco	<0.1	Waves recorded for 24 hours.
1854 10/22	N. California San Francisco	2-3	E	San Francisco	Observed	Vessels swayed. Water rose 0.6 m with high waves in calm weather near Angel Island.
1854 12/23	Enshunada, Japan	4	E	San Diego San Francisco	<0.1 <0.1	Recorded on marigram, earliest known tsunami recording.
1854 12/24	Nankaido, Japan	4	E	San Diego San Francisco	<0.1 <0.1	Recorded on marigram “
1855 3/20	N. California Humboldt Co.	1	E	Humboldt Bay	Observed	Water in bay agitated for an hour.
1855 7/11	S. California	3	L	San Juan Capistrano	Observed	Two large waves surged on shore.
1856 2/15	N. California San Francisco	3	L	San Francisco	0.6	Water rose and stayed high for 5 minutes. Followed 5.9 earthquake.
1856 8/23	SE Hokkaido Island, Japan	4	E	San Francisco San Diego	<0.1 <0.1	Recorded on marigram
1859 9/24	N. California	2	A	Half Moon Bay	4.6	Schooner damage. Small earthquake at 5:50 AM.

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1861 5/4	N. California	0	A	San Francisco	Observed	Tide dropped 30-45 cm below lowest low tide during the week.
1862 5/27	S. California	4	L	San Diego	1.2	0.9 to 1.2 m runup. Possibly inundation rather than runup.
1865 10/8 <sup>2</sup>	C. California Santa Cruz	3	L	Santa Cruz	Observed	High flood tide and strong ebb tide following collapse of cliffs into bay, followed 6.5 earthquake.
1868 4/3	Hawaii	4	E	San Diego San Francisco	0.1 <0.1	Recorded on marigram.
1868 8/13	N. Chile	4	E	San Diego  San Francisco San Pedro Wilmington Beach	0.3  0.3 0.8 0.8	45.7 cm bore. Wharf submerged.
1868 10/21	N. California Hayward fault 7.0 earthquake	1  1 3  2	L	Government Island Sacramento San Francisco  Santa Cruz	Observed  Observed 4.5  Observed	Registered on tide gauge.  0.61 m wave observed. 6.0 M surge on shore at Cliff House. Water rushed up river.
1869 2/10	N. California San Francisco	1	M	Fort Point, San Francisco	Observed	Earthquake recorded on tide gage?
1869 6/1	N. California	3	E?	Fort Point	Observed	Earthquake waves recorded on tide gage.
1872 3/26	S. California	0	E	San Pedro	Observed	Ship Damaged.
1872 8/23	Fox Islands, Aleutian Is.	3	E	San Diego San Francisco	<0.1 <0.1	First instrumental location for a tsunamigenic earthquake.
1872 9/16	Fox Is. AK(?)	3	?	San Francisco San Diego	0.1 0.1	Oscillations recorded.
1873 11/23	N. California	3	E	Crescent City	Observed	
1875 10/12-14	N. California	0	M	Davenport	Observed	Wharf destroyed, waves on 12th, earthquake on 14th.
1877 5/10	N. Chile	4	E	Anaheim Gaviota San Francisco San Pedro Santa Cruz Sausalito Wilmington	0.9 1.8 0.2 1.0 Observed 0.2 1.7	Swift currents. Observed. Recorded.  Observed. Two waves observed. Observed.
1878 11/22	S. California	3	L	Avila Cayucos Sal Cape	Observed Observed Observed	Some wharf damage. Wharf damage. 1 killed, half of wharf destroyed.
1879 8/10	S. California	2	L	Santa Monica	Observed	
1883 8/27	S. Java Sea Krakatau	2	V	Sausalito	0.1	Air pressure wave recorded on marigram.
1887 7/8	N. California	2	L?	Sausalito	Observed	Distinct waves. No source known.

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1895 3/9 and 30	S. California	2	L	San Miguel Is.	Observed	Bluffs collapsed into bay. Wave reports doubtful.
1896 6/15	Sanriku, Japan	4	E	Mendocino San Francisco Santa Cruz Sausalito	1.0 0.2 1.5 0.1	Log booms threatened. Sand bag dike overtopped & festival float destroyed.
1898 <sup>3</sup> 3/31	N. California 6.7 EQ Rogers Cr. fault	3	E	San Francisco Bay	0.6	Earthquake on the Rogers Creek fault. Tossed boats in the bay.
1901 3/3	N. California	3	L	Monterey	Observed	Earthquake near Parkfield. High waves, bay muddy.
1906 1/31	Columbia-Ecuador	4	E	San Diego San Francisco	<0.1 Observed	Currents observed, boats turned.
1906 4/18	N. California	4	E	Navarro River  San Francisco	Observed  0.1	Flooding of low-lying areas. Slight drop in water level. Recorded on marigram.
1906 8/17	Central Chile	4	E	San Diego San Francisco	<0.1 <0.1	
1917 5/1	Kermadec Is., South Pacific	4	E	La Jolla San Francisco San Diego	Observed <0.1 <0.1	
1917 6/26	Samoa Is.	4	E	Presidio San Diego	<0.1 <0.1	
1918 9/7	Kuril Is., Russia	4	E	San Francisco	<0.1	
1918 11/8	Kuril Is.	2	A	San Diego Presidio	<0.1 <0.1	Recorded.
1918 12/4	Chile	4	E	Presidio	Observed	Emergent.
1919 4/30	Tonga Is.	4	E	San Diego San Francisco	0.1 Observed	
1922 11/11	N. Central Chile	4	E	San Diego San Francisco Santa Cruz Los Angeles	0.2 0.2 Observed Observed	
1923 1/22	N. California	2	E	Cape Mendocino	<0.1	Recorded on tide gage.
1923 2/3	Kamchatka Peninsula, Russia	4	E	San Diego San Francisco Santa Cruz Los Angeles	0.2 0.1 Observed Observed	
1923 4/13	Kamchatka Peninsula, Russia	4	E	San Diego San Francisco Los Angeles	<0.1 Observed 0.1	Vessels set adrift in harbor.
1927 11/4	C. California EQ off Pt. Arguello	4	E	La Jolla Pismo Beach Port San Luis San Diego San Francisco Surf	<0.1 Observed 0.8 Observed <0.1 1.8	Recorded on tide gage.  Recorded on tide gage. Recorded on tide gage.
1928 6/17	S. Mexico	4	E	La Jolla San Francisco Los Angeles	<0.1 <0.1 <0.1	
1929 3/7	Fox Is.,	4	E	Presidio	<0.1	Recorded.

	Aleutian Is.					
1930 8/31	S. California	3	L?	Santa Monica Redondo Beach Venice Beach	6.1 Observed 6.1	16 rescued, Boat/pier damage. 1 death, many rescued. High waves.
1931 10/3	Solomon Is.	4	E	San Diego Santa Barbara	<0.1 <0.1	
1932 6/3	Jalisco, Mexico	4	E	Long Beach Los Gatos San Diego San Francisco Santa Barbara	0.1 trace <0.1 trace <0.1	
1933 3/2	Sanriku, Japan	4	E	La Jolla Long Beach San Diego San Francisco Santa Monica	<0.1 <0.1 <0.1 <0.1 0.1	
1938 11/10	Alaska Peninsula	4	E	Crescent City San Diego Santa Monica	0.2 <0.1 0.1	
1943 4/6	N. Central Chile	4	E	Crescent City San Francisco San Diego Terminal Is LA	trace <0.1 0.1 0.1	
1944 12/7	Ryukyu Trench, Japan	4	E	La Jolla Port Hueneme San Francisco San Diego Santa Monica Terminal I LA	trace 0.1 <0.1 <0.1 <0.1 <0.1	
1946 4/1	E. Aleutian Is. Unimak Island	4	E, L	Alameda Arena Cove  Avila  Bolinas  Carpenteria Caspar Beach Catalina Isl Crescent City Drakes Bay Granada Half Moon Bay La Jolla Long Beach  Los Angeles Monterey Morro Bay Muir Beach  Navarro River Noyo	0.2 2.4  1.3  Observed  Observed Observed 1.8 0.9 2.6 Observed 2.6 0.2 0.2  0.4 Observed 1.5 Observed  Observed 1.4	Wave height 4.3 m above MLLW. Water overtopped breakwater. A small island submerged and boats sunk.   Small pier washed away.  Boat washed on highway. \$1000 in damage  Undertow reported by swimmers.   Wave reported as 4.8 m above MLLW. Water rose to top of pier. 100 fishing boats thrown 1.8m up bank.

1946 4/1 continued				Pacific Grove	Observed	Rooms flooded at municipal pool 1 m
				Pacifica	Observed	
				Pismo Beach	Observed	
				Point Arguello	1.1	
				Port Hueneme	0.8	Sand deposited on railroad track
				Princeton	Observed	Boulders washed away, \$20,000 damage.
				San Diego	0.2	Recorded on marigram
				SF Presidio	0.3	“
				SF Hunters Pt	0.1	
				San Luis	1.2	Recorded, tanker torn from mooring lines.
				Obispo		
				San Mateo	<0.1	
				San Pedro	0.4	
				San Simeon	Observed	Tender & 2 cargo ships broke lines.
1946 12/20	Nankaido, Japan	4	E	Santa Barbara	0.9	
				Santa Cruz	1.5	Man drowned, 3.8 to 4.6 m above MLLW.
				Santa Monica	Observed	Observed by swimmers.
				Ventura	Observed	
1946 12/20	Nankaido, Japan	4	E	Avila	0.1	Recorded on marigram.
				Crescent City	0.2	“
				San Francisco	<0.1	“
				Terminal Is.	0.1	“
1952 3/4	SE Hokkaido, Japan	4	E	Alameda	<0.1	Recorded on marigram.
				Crescent City	0.2	“
				La Jolla	<0.1	“
				Long Beach	0.1	“
				Oceanside	0.1	“
				Port Hueneme	0.1	“
				San Diego	<0.1	“
				San Francisco	<0.1	“
				Sausalito	<0.1	“
1952 11/4	Kamchatka Peninsula, Russia	4	E	Alameda	0.4	Recorded on marigram.
				Avila	1.4	Recorded on marigram.
				Crescent City	1.0	4 boats overturned, concrete buoys moved.
				La Jolla	0.1	Recorded on marigram.
				Long Beach	0.3	“
				Los Angeles	0.3	“
				Port Hueneme	0.7	“
				San Diego	0.4	“
				SF Hunters Pt.	0.2	“
				SF Presidio	0.5	“
				San Pedro	0.3	“
				Santa Cruz	Observed	Boat damaged; sand washed away.
1956 3/30	Kamchatka Peninsula, Russia	4	E	Santa Monica	0.5	Recorded on marigram.
				Avila	0.1	Recorded on marigram.
1957 3/9	Central Aleutian Is.	4	E	Alameda	0.2	Recorded on marigram.
				Anaheim Bay	0.4	“
				Avila	0.5	“

1957 cont.				Bodega Cambria Crescent City La Jolla Long Beach Los Angeles Monterey Newport Bay Noyo Port Hueneme San Diego  San Francisco San Pedro Santa Monica	0.3 Observed 0.7 0.3 0.3 0.3 0.6 0.1 Observed 0.5 0.2  0.3 0.2 0.5	Recorded on marigram. Water crossed sand bar. Recorded on marigram. Minor damage. Recorded on marigram. “ 2 people swept off rocks Recorded on marigram. Barely noticed. Recorded on marigram. Damage at \$5,000. Wall of water 1 m high reported at Shelter Is. Recorded on marigram. “ “
1958 11/6	S. Kuril Is., Russia	4	E	Port Hueneme San Francisco Avila	0.1 0.2 0.1	Recorded on marigram. “ “
1960 5/22 <sup>4</sup>	S. Central Chile	4	E	Alameda Alamitos Bay Avalon Avila Benicia Berkeley Bodega Bay Cambria  Capitola Crescent City  Gualala River  Humboldt Bay  Hunters Point La Jolla Long Beach  Los Angeles Mare Island Monterey  Morro Bay Moss Landing Noyo Oakland Oceano Pacific Grove Pacifica Pismo Beach  Port Hueneme	0.3 0.6 0.6 0.9 <0.1 Observed 0.3 Observed  Observed 1.7  0.6  Observed  0.1 0.5 0.7  0.8 <0.1 1.1  Observed 0.8 Observed 0.37 Observed 0.9 1.2 1.4  1.3	Recorded on marigram.   Surges. Recorded on marigram Surges, boats bobbed. Recorded on marigram Wave crossed Santa Rosa Cr. sand bar Wave over sea wall 2 ships destroyed, \$30,000 damage 0.6m wave at entrance, washed over bar Currents at Bay entrance & at Eureka. Recorded on marigram. “ \$500,000 - \$1 million damages. 1 drowned, 1 injured Recorded on marigram. 1.5m wave, 1 killed, boat broke mooring. Severe currents. 1.5m wave observed, severe currents 6 boats broke mooring, Piers damaged Recorded on marigram Ramp engulfed Concession stand displaced Dock damaged, boats broke mooring

1960 cont.				Princeton	2.2	Boats beached, boat overturned.
				San Diego	0.7	80 m of dock destroyed, bridge damaged. Barge sunk, 8 slips destroyed.
				San Francisco	0.89	Strong currents.
				San Pedro	0.5	Recorded on marigram.
				San Rafael	Observed	Boat torn from mooring.
				Santa Barbara	1.4	\$20,000 damage.
				Santa Cruz	0.9	1.8m wave observed, high wave action.
				Santa Monica	1.6	Boats broke mooring.
				Shelter Cove	0.6	
				Stinson Beach	1.5	1.2m waves observed.
				Terminal I.	0.9	3m wave observed.
				Tomales Bay	Observed	Strong currents in entrance.
1963 10/13	Kuril Is., Russia	4	E	Avila	0.3	Fishing boat broke mooring.
				Crescent City	0.5	
				Los Angeles	<0.1	
				La Jolla	0.1	
				San Francisco	<0.1	
1964 3/28 <sup>5</sup>	Gulf of Alaska - Alaska Peninsula	4	E	Alameda	0.8	
				Alamitos Bay	0.4	
				Albion River	Observed	2.7 m above MLLW, bores 2km upstream
				Arena Cove	1.8	
				Avila	1.6	Boats broke mooring, \$2,000 damages
				Bodega Bay	0.8	1 drowned next day.
				Benicia	0.12	
				Bolinas	Observed	
				Capitola	2.1	
				Caspar Beach	Observed	Hwy 1 flooded.
				Cayucos	Observed	Parking lot flooded.
				Crescent City	4.8	11 deaths 290 homes and businesses damaged. 6.3 m above MLLW.
				Drakes Bay	Observed	2.4 m above MLLW.
				Half Moon B	Observed	3.1 m above MLLW, boat sank.
				Humboldt Bay	1.9	Street flooded, strong currents.
				Jenner Beach	Observed	3.0 m above MLLW.
				Klamath River	Observed	1 killed, \$4,000 damage at Requa.
				La Jolla	0.3	
				Long Beach	Observed	8 docks destroyed \$100,000 damage
				Los Angeles	0.5	\$200,000 damages
				Mare Island	Observed	0.16 m above MLLW
				Marin Co.	Observed	\$1 million damage
				Martins Beach	3.0	

1964 cont.				Monterey	1.4	Small boats broke loose, \$1,000 damage.
				Morro Bay	Observed	Fuel dock lost, \$10,000 damage.
				Moss Landing	1.4	2.7 m above MLLW.
				Muir Beach	Observed	
				Newport Bay	0.5	Recorded on marigram.
				Noyo	2.0	100 fishing boats damaged, 10 sunk.
				Oakland	Observed	
				Oceano	Observed	Heavy surf.
				Oxnard	Observed	
				Pacific Grove	0.9	Recorded on marigram.
				Pacifica	1.4	\$200 damage.
				Pebble Beach	Observed	4.5 m above MLLW.
				Pismo Beach	Observed	
				Point Arena	Observed	3.7 m above MLLW.
				Rio Del Mar	Observed	Negligible damage.
				Russian Gulch	Observed	3.4 m above MLLW.
				Salmon Cr. B	Observed	3.6 m above MLLW.
				San Diego	0.6	Floating restaurant mooring broke.
				San Francisco	1.1	Recorded on marigram.
				San Rafael	1.5	\$77,500 damage to boats and berths
				San Simeon	Observed	
				Santa Barbara	0.8	Minor damage, recorded.
				Santa Catalina	Observed	
				Santa Monica	1.0	Boat sunk, damaged.
				Sausalito	1.2	\$100,000 damage at Clipper Yacht Harbor.
				Sea View	3.8	
				Smith River	Observed	4.1 m above MLLW, \$6,000 damage.
				Tomales Bay	1.0	\$6,000 damage to pier
				Trinidad	Observed	5.4m above MLLW.
				Van Damme	Observed	2.6 m above MLLW, bore up Little River
				Ventura	Observed	
1965 2/4	W Aleutian Is.	4	E	Crescent City	0.1	Recorded on marigram.
				Los Angeles	<0.1	“
				San Francisco	<0.1	“
				San Diego	<0.1	“
				Santa Cruz	<0.1	“
				Santa Monica	<0.1	“
1966 10/17	Peru	4	E	Avila	<0.1	Recorded on marigram.
				Crescent City	0.1	“
				Long Beach	<0.1	“
				Los Angeles	<0.1	“
				Newport Bay	<0.1	“
				Rincon Island	<0.1	“
				San Diego	<0.1	“
				San Francisco	<0.1	“
1968 5/16	Honshu, Japan	4	E	Alameda	<0.1	Recorded on marigram.
				Avila	<0.1	“



1968 cont.				Crescent City LaJolla Long Beach Los Angeles Newport Bay Rincon San Diego San Francisco Santa Monica	0.6 <0.1 0.1 <0.1 <0.1 <0.1 <0.1 <0.1 0.2	“ “ “ “ “ “ “ “ “
1971 7/26	New Ireland	4	E	Crescent City Long Beach Los Angeles	<0.1 <0.1 <0.1	Recorded on marigram. “ “
1974 10/3	Peru	4	E	Crescent City	<0.1	Recorded on marigram.
1975 11/29	Hawaii	4	E	Bodega Bay Imperial Bch La Jolla Long Beach Port San Luis San Diego San Francisco Santa Catalina Santa Monica	0.2 0.2 0.1 <0.1 0.4 <0.1 <0.1 1.4 Observed	Recorded on marigram. “ “ “ “ “ “ “ \$1,000 damage to two docks. Surge observed.
1977 6/22	Tonga Trench	4	E	Long Beach Los Angeles Port San Luis San Diego	0.1 <0.1 0.1 <0.1	Recorded on marigram. “ “ “
1986 5/7	Aleutian Is.	4	E	Crescent City	0.1	Recorded on marigram.
1987 11/30	Gulf of Alaska	4	E	San Francisco	<0.1	Recorded on marigram.
1988 3/6	Gulf of Alaska	2	E	San Francisco?	<0.1	Report not confirmed.
1989 10/18	N. California	4	E	Santa Cruz  Monterey Moss Landing	Observed  0.4 1.0	Wave rushing out of harbor. Recorded on marigram. Water drained from Salinas River.
1992 4/25	N. California	4	E	Arcadia Arena Cove Alameda Clam Beach  Crescent City  Humboldt Bay  Monterey Point Reyes Port San Luis San Francisco Trinidad	0.1 0.1 <0.1 Observed  0.6  0.3  <0.1 0.1 <0.1 <0.1 0.9	Recorded on marigram. “ “ Water level changed several feet Oscillations in harbor, 4th wave highest. Waves arrived 20 min. after EQ Recorded on marigram “ “ “ Cars stuck on beach.
1994 10/04	Kuril Islands	4	E	Crescent City	1.1	Recorded on marigram

2001 6/22	Southern Peru	4	E	San Diego La Jolla Los Angeles Santa Monica Point San Luis Monterrey San Francisco Pt. Reyes Arena Cove Crescent City	0.1 0.1 0.1 0.2 0.27 0.15 0.07 0.2 0.15 0.4	Recorded on marigram. “ “ “ “ “ “ “ “ “ “
2003 9/25	Hokkaido, Japan	4	E	Crescent City North Spit Arena Cove Pt. Reyes Pt. San Luis San Francisco Monterrey	0.35 0.08 0.04 0.06 0.06 0.05 0.09	Recorded on marigram. “ “ “ “ “ “ “
2003 11/17	Rat Islands, Alaska	4	E	North Spit	0.1	Recorded on marigram.
2004 12/28	Northern Sumatra	4	E	San Diego La Jolla Los Angeles Santa Monica Point San Luis Monterrey San Francisco Pt. Reyes Arena Cove Crescent City	0.2 0.05 0.2 0.30 0.45 0.07 0.10 0.22 0.15 0.42	Recorded on marigram. “ “ “ “ “ “ “ “ “ “
2005 6/15	N. California Gorda plate	4	E	Crescent City	0.26	Recorded on marigram.

\* Validity: (Soloviev and Go, 1974; and Cox and Morgan, 1977)

- 0 = Not a valid report
- 1 = Probably not a valid report
- 2 = Possibly a valid report
- 3 = Probably a valid report
- 4 = Certainly a valid report

\*\* The key to the cause of the event is as follows:

- L = Landslide
- M = Meteorological
- A = Astronomical
- E = Earthquake
- V = Volcano

Additional source information:

<sup>1</sup> Satake, K., Shimazake, Y., Tsuji, Y., Uyeda, K., 1996, Time and size of a giant earthquake in Cascadia inferred from Japanese tsunami records of January, 1700, *Nature*, 379, 246-249.

<sup>2</sup> Topozada, T.R., Branum, D.M., Reichle, M.S., Hallstrom, C.L., 2002, San Andreas fault zone, California:  $M \geq 5.5$  earthquake history, *Bull. Seism. Soc. Am.*, 92, No. 7, 2555-2601.

<sup>3</sup> Topozada, T.R., Bennett, J.H., Hallstrom, C.L., Youngs, L.G., 1992, 1898 “Mare Island” earthquake at the southern end of the Rodgers Creek fault, in Bortchardt, Glenn and others, editors, *Proceedings of the second Conference on Earthquake Hazards in the Eastern San Francisco Bay Area*, California Department of Conservation, Division of Mines and Geology Special Publication 113, 385-392.

<sup>4</sup> Magoon, O.T., 1962, The tsunami of May 1960 as it affected Northern California, ASCE Hydraulics division Conference, Davis, California

<sup>5</sup> Magoon, O.T., 1966, Structural Damage by Tsunamis, Proceedings, American Society Civil Engineers, Specialty Conference on Coastal Engineering, Santa Barbara (California), Oct. 1965, 35-68.